MDX Sparc-LE ® 20

User Manual

5700306-H

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User Manual

MDX Sparc-LE ® 20

5700306-H

ADVANCED ENERGY®

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Read this entire manual and all other publications pertaining to the work to be performed before you install, operate, or maintain this equipment. Practice all plant and product safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage. All personnel who work with or who are exposed to this equipment must take precautions to protect themselves against serious or possibly fatal bodily injury.

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Introduction

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READ THIS SECTION!

We know that some of you operate the Sparc-LE 20™ accessory now and that you don't feel you have the time to read the entire manual. Below is a list of manual sub-sections you must read before getting started.

- Theory of Operation
- Electrical Specifications
- Connectors and Pin Descriptions
- Operating Overview

In addition, we recommend that you scan *Organization of the Manual* and *Interpreting the Manual*, which are short sections intended to guide you through the manual. *Organization of the Manual* helps you more quickly find what you need. *Interpreting the Manual* explains the type conventions (what it means when a word appears in capitalized italic type, for instance) and icon (symbol) definitions.

ORGANIZATION OF THE MANUAL

The main table of contents is an outline of the manual's major topics. It contains only the chapter titles and the first- and second-level headings within each chapter; thus you can skim these pages and get an idea of what the manual contains, without being overwhelmed by several heading levels.

At the beginning of each chapter, a table of contents lists each sub-heading in the chapter and its page number. The Index gives you a topic analysis.

INTERPRETING THE MANUAL

Type Conventions

To help you quickly pick out what is being discussed, the manual presents certain words and phrases in type that are different from the rest of the text. We use the following type conventions:

- Pin and signal names appear in capitalized italics (*DUTY CYCLE.A*).
- Labels that are on the unit (switches, indicators, etc.) generally appear in boldface capital letters (**MODIFY**). Exceptions are port names, which simply begin with a capital letter (User port).
- Functions are printed in boldface lowercase letters (**analog input filtering**).

Icons (Symbols)

This symbol represents important notes concerning potential harm to people, this unit, or associated equipment. It is found whenever needed in the manual.

We include this symbol in Danger, Warning, and Caution boxes to identify specific levels of hazard seriousness.

DANGER:
This box identifies immediate hazards which will result in severe personal injury or death.

WARNING:
This box identifies hazards or unsafe practices which could result in severe personal injury or death.

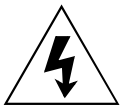
CAUTION:
This box identifies hazards or unsafe practices which could result in minor personal injury or product or property damage.

The following symbols could appear on labels on your unit.

- Short circuit protected

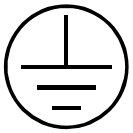
1024

- High voltage



1028

- Protective earth ground



1029

- Warning (refer to manual)

1027

SAFETY

Do not attempt to install or operate this equipment if you have not first acquired proper training.

- Make sure that this unit is properly grounded.
- Ensure that all cables are properly connected.
- Verify that input line voltage and current capacity are within specifications before turning on the power supplies.
- Use proper ESD precautions.
- DO NOT BE CARELESS AROUND THIS EQUIPMENT.

> ⚠ **WARNING:**
> RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.

INSTALLATION REQUIREMENTS

Operating and maintenance personnel must receive proper training before installing or maintaining high-energy electrical equipment. Potentially lethal voltages could cause death, serious personal injury, or damage to the equipment. Ensure that all appropriate safety precautions are taken.

This unit requires the addition of a Protective Earth ground conductor on the rear panel and the use of a shielded power cable on the input terminal block.

Theory

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GENERAL DESCRIPTION

The Sparc-le 20 (Small Package Arc Repression Circuit-Low Energy) 20 kHz unit is an add-on accessory for the Advanced Energy magnetron drive power supplies with output currents under 25 A. Its main function is to enhance the arc- handling capability of the MDX power supply. Even though the MDX power supplies exhibit excellent arc-handling characteristics (such as low output energy storage and recovery response time to hard arcs of under 10 ms), the demand for improved film quality with even fewer defects has arisen. This demand has led to the development of the Sparc-le 20 technology, which clears arcs in microseconds and dramatically reduces the number of hard arcs.

The Sparc-le 20 add-on accessory is a cost effective alternative to improving sputtered film quality. Its small size, coupled with minor modifications to the system cables, allows it to be easily retro-fitted into existing systems.

Activation Counting

Users have found that a knowledge of the arcing rate over the life of a target or over the duration of a process cycle can be used as a measure to explain defects or poor film quality. The Sparc-le 20 unit includes an isolated signal connected to a BNC connector which can be monitored by a counter. Each time a Sparc-le 20 unit suppresses an arc, a 5-V, 5-µs signal, arc suppression signal is generated. During heavy arcing, the pulse width may become less than 5 µs. During the self-run mode, the activation counter generates a signal only when an arc is suppressed between the pulses. That is, the self-run frequency cannot be monitored on this output.

Supervisory Circuit

An internal supervisory circuit within the Sparc-le 20 unit monitors its function in the active arc-handling and self-run modes. The purpose of this circuit is to notify the operator that the Sparc-le 20 unit is not functioning properly; this prevents yield loss in critical processes. A signal is produced at the Sparc-le 20 User port in the case of a unit malfunction. The load current must exceed 1.5 A before the supervisory circuit becomes operational.

THEORY OF OPERATION

The Sparc-le 20 unit is inserted between the MDX power supply and the chamber, see Figure 2-1 . It is connected in series with the output of the MDX power supply and physically located close to the chamber. The Sparc-le 20 circuitry responds to arcs within microseconds and therefore requires that the impedance (distance) between it and the chamber be kept to a minimum.

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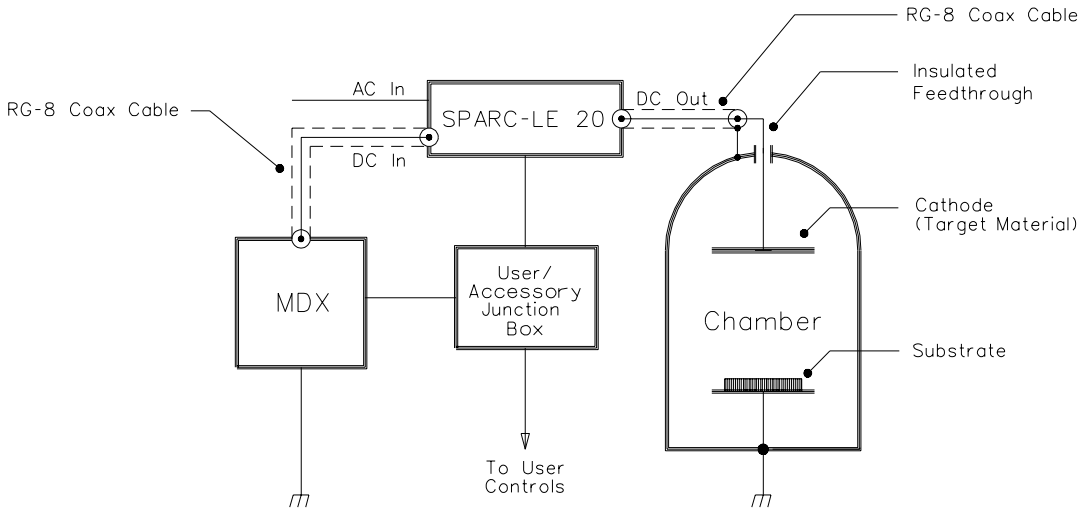

Figure 2-1. Physical location of Sparc-le 20 in a system

The Sparc-le 20 unit's arc-handling current characteristic immediately shunts the target current away from the target and starves the arc. By removing the current source and, for a short time, reversing the target voltage, the arcs are quenched quickly.

The Sparc-le 20 has three operating modes:

- Active Arc-handling mode
- Self-run mode
- Arc-Out enhancement mode

Active Arc-Handling Mode

The active arc-handling mode is the primary operating mode of Sparc-le 20 unit. You can select this mode from the front panel or the User port. In this mode, the target current is immediately shunted away from the target when an arc is about to begin. When the current source is removed and the target voltage is reversed for a short time, the arcs are quenched quickly.

An illustration of the Sparc-le 20 unit's arc-handling characteristics in the active arc-handling mode is shown in Figure 2-2and Figure 2-3. Arcs can be handled at a rate of up to 40,000 arcs per second. If this rate is continuously exceeded, the unit overheats and automatically switch over to the arc-out enhancement circuit for target cleaning. After clearing the arc, the Sparc-le 20 unit requires at least 10 µs for the internal pulse transformer core to reset. Should another arc occur before this 10 µs has elapsed, this arc might not be cleared by the Sparc-le 20 unit. In this case, the arc may become a hard arc and draw excessive current until the MDX power supply turns off. After the MDX supply clears the hard arc, it automatically turns back on and the process continues.

Prior to an arc occurring, the target voltage collapses on most chambers. That is, while the system is operating at a negative potential, voltage drops sharply towards zero volts. How far the target voltage collapses depends upon the target material. Higher impedance target materials tend not to drop as far as lower impedance targets. This voltage change is used to trigger the Sparc-le 20 unit into action. The Sparc-le 20 unit uses an automatic tracking trigger circuit which allows the user to operate over the entire output voltage range without adjustment.

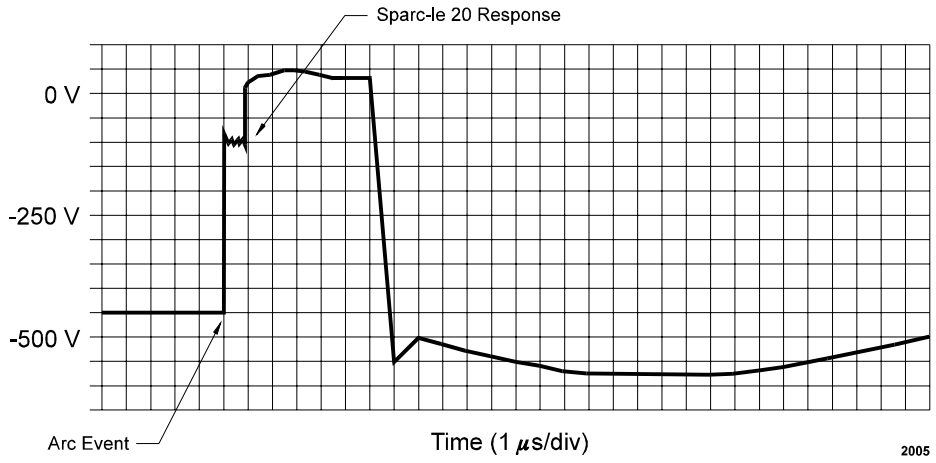

Figure 2-2. Target voltage during active arc-handling mode

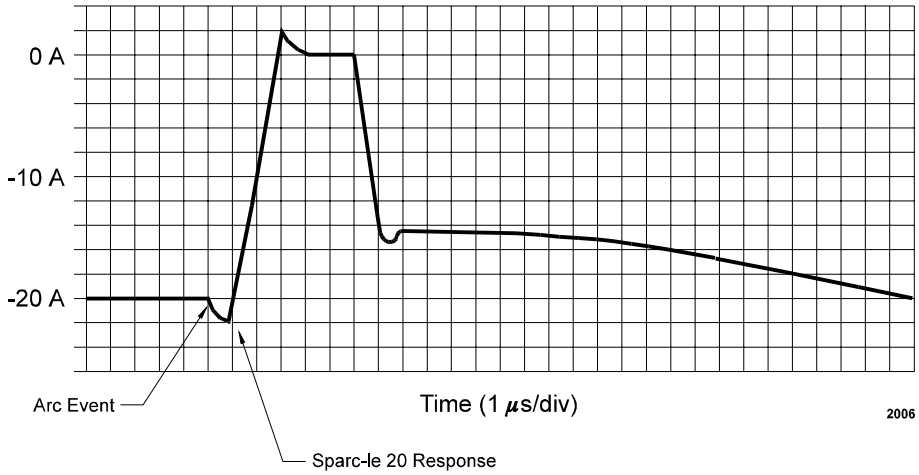

Figure 2-3. Target current during active arc-handling mode

Self-Run Mode

You can select this mode through the Sparc-le 20 front panel or User port. When selected, the Sparc-le 20 unit shorts out and reverses the target voltage for 5 µs at a 20-kHz rate. This reversal of voltage prevents charge buildup on the system surfaces, slows the growth of oxide films, and extends target life. During this self-run mode, the Sparc-le 20 unit continues to process arcs as they occur (up to a 40 kHz rate). This is also what happens in active arc mode.

At operation above 700 V, the internal self-run frequency automatically shifts to 15 kHz. This lower self-run frequency is required to lower the power dissipation in the snubber resistors.

The self-run mode selection engages a 20-kHz oscillator which triggers the Sparc-le 20 power switches. This action produces the same output characteristics as if an arc were about to start. The only difference is that the activation effect is created internally by the Sparc-le 20 switches and not by an arc in the chamber. The Sparc-le 20 switches first discharge the chamber capacitance and then reverse the chamber voltage. This voltage reversal on the target prevents charge buildup on the system surfaces and slows insulating film build-up. Normal arcs, which may occur while the self-run mode has been selected, are processed the same way, at a maximum rate of 20,000 arcs per second. The self-run mode can only operate when Sparc-le 20 unit has been turned on or enabled. It will not function if Sparc-le 20 unit is in the arc-out enhancement mode.The self-run mode frequency of 20 kHz can be changed to match the original Sparc-le unit's self-run mode frequency of 2 kHz. See “Changing Self-run Frequency” on page 5-2.

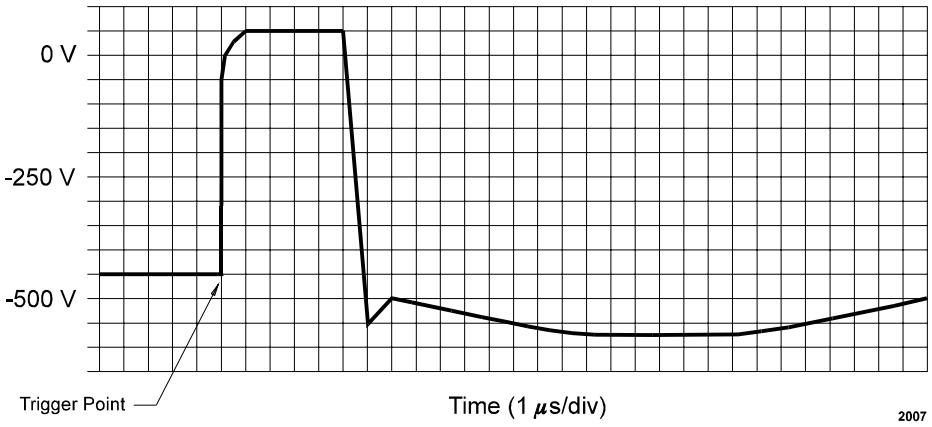

Figure 2-4. Target voltage during self-run mode

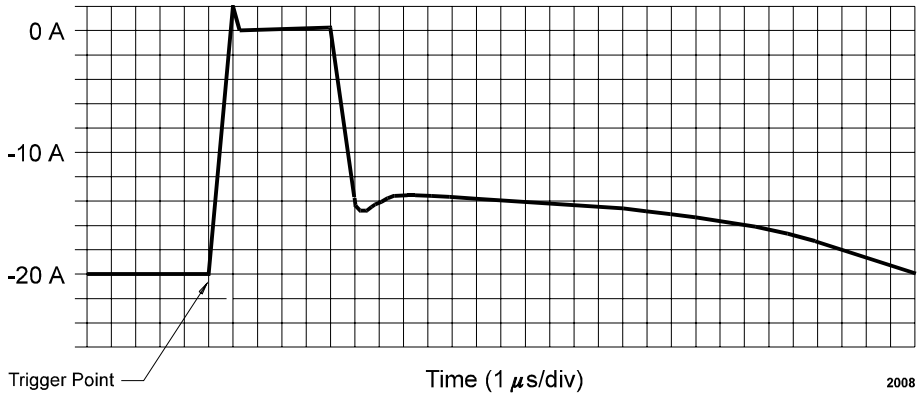

Figure 2-5. Target current during self-run mode

Arc-Out Enhancement Mode

The arc-out enhancement mode is active when the Sparc-le 20 unit is turned off or not enabled. The arc-out circuit consists of passive components and clamp rectifiers only. During an arc, it functions as a resonant LC network which discharges and then commutates off the arc through its reversing action. This process is also very fast, and arcs can be suppressed in under 20 µs. The target voltage and current for this mode are shown in Figure 2-6 and Figure 2-7.

For certain target materials, some arc energy is required to initially clean the target of arcing sites. In these cases, the Sparc-le 20 unit is so effective in lowering arc energy that a long period is necessary for new target conditioning. Also, experience has shown that when AE's new arc-out enhancement circuit is used, the target is cleaned more quickly than with the standard MDX supply alone. The Sparc-le 20 design anticipates its use with older MDX models not having this new feature and therefore includes the new arc-out enhancement circuitry. When the Sparc-le 20 is turned off, it automatically switches in the arc-out enhancement circuit.

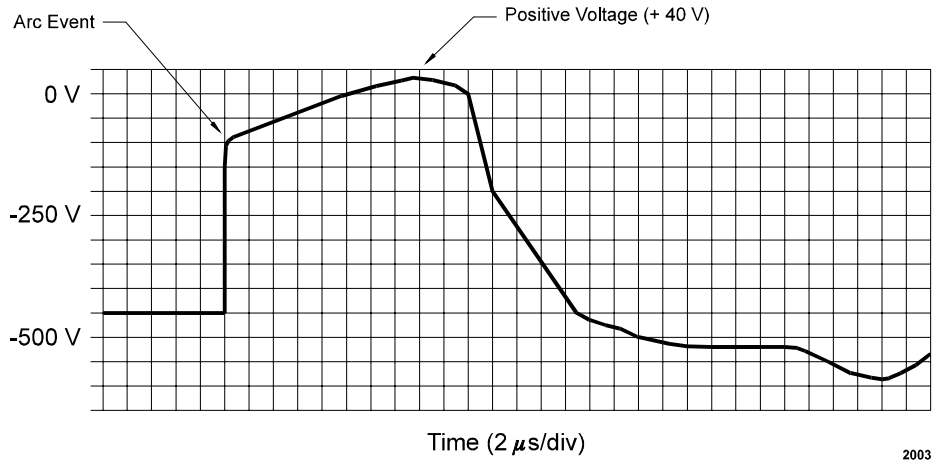

Figure 2-6. Target voltage during arc-out enhancement mode

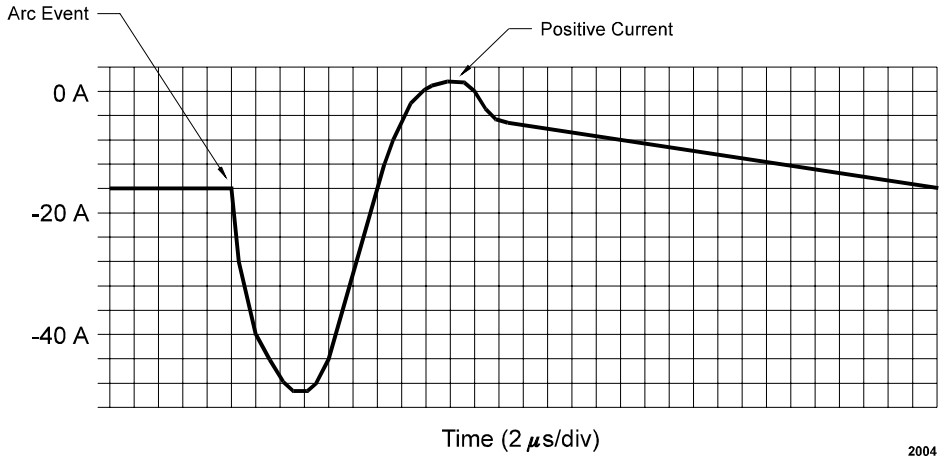

Figure 2-7. Target current during arc-out enhancement mode

Specifications

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FUNCTIONAL SPECIFICATIONS

The following table lists the functional specifications.

Table 3-1. Functional Specifications

Control Signal Source	MDX User Port
Fault Conditions	An overtemperature condition causes the Sparc-le 20 unit to cease functioning in its active arc-handling mode. It automatically switches to the ARC-OUT enhancement mode. An overtemperature condition is indicated by the **OVERTEMP** LED on the front panel. An over-voltage condition (input voltage to the Sparc-le 20 unit exceeds 1000 V) prevents the Sparc-le 20 unit from operation in its active arc-handling mode. It automatically switches to the ARC-OUT enhancement mode. When the input voltage drops below 1000 V, the Sparc-le 20 unit switches back automatically to the prior arc-handling mode. and over-voltage condition is reported as a low output on *pin 7* of the Sparc-le 20 User port. An open signal on pin 9 of the User port means a loss of ac power to the Sparc-le 20 unit, or an overtemperature condition, or an open interlock switch.

PHYSICAL SPECIFICATIONS

The following table lists the physical specifications.

Table 3-2. Physical Specifications

DC Input and Output Connectors	UHF type, female, Amphenol part number 83-1R Optional: 2-position terminal block or MS-3470 connectors (male for input, female for output)
Cable Connector for DC Input and Output	UHF type, male, Amphenol part number 83-822 Optional: terminal block or MS-3476 connector
DC Input and Output Cables	RG-8U coaxial cable; output cable from Sparc-le 20 to chamber not to exceed 6 m (20 ft.)
Size	13.3 cm x 48.3 cm x 19.4 cm (5.25" (H) x 19"(W) x 7.65" (D))
Weight	7.7 kg (17 lb) maximum

ELECTRICAL SPECIFICATIONS

The following table lists the electrical specifications.

> ⚠ **WARNING:**
> Positive voltage output with a negative ground is prohibited. Hardware damage will occur.

Table 3-3. Electrical Specifications

AC Input Voltage	90 to 126.5 V ac rms, 50/60 Hz, single phase, 30 VA 180 to 253 V ac rms, 50/60 Hz, single phase, 30 VA
DC Input Voltage	Any low-Z or standard-Z output from an MDX magnetron supply
DC Current	25 A steady state maximum. No minimum current is required for operation. The supervisory circuit requires a minimum of 1.5 A before it is operational. ***Note:*** *Low power* Sparc-le 20 units should be operated only up to 3 A. If you are unsure whether you have a low power Sparc-le 20 unit, please note the part number on the unit (315xxxx-xxx) and contact AE.
Input and Output DC Polarity	Negative output (positive at ground); Negative output (positive floating less than 100 V from ground)

Table 3-3. Electrical Specifications

Reverse Recovery Voltage	10% of input voltage
Arc-handling Characteristics	40,000 arcs/sec. maximum; 4 to 6 µs typical arc recovery time; 1,800 V absolute maximum input dc voltage; 150 V minimum to 1000 V maximum output operating range; 7 to 11 µs delay before next arc can be processed

ENVIRONMENTAL SPECIFICATIONS

The following table lists the environmental specifications.

Table 3-4. Environmental Specifications

Ambient Temperature:	
Operating	Minimum 0º C, maximum 40º C (maximum value of average over 24 hr.: 35º C)
Storage	Minimum -25º C, maximum 55º C
Transportation	Minimum -25º C, maximum 55º C (for short periods of up to 24 hr., the maximum is 70º C)
Coolant Temperature	Air (gas) minimum 0º C, maximum 35º C
Coolant Flow Parameters:	
Contamination	Cooling air should be free of corrosive vapors and particles, conductive particles, and particles that could become conductive after exposure to moisture.
Humidity	15% to 85% relative humidity; no condensation or icing
Atmospheric Pressure:	
Operating	800 mbar minimum (approximately 2000 m above sea level)
Storage	800 mbar minimum (approximately 2000 m above sea level)
Transportation	660 mbar minimum (approximately 3265 m above sea level)

Connectors, Indicators and Controls

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CONNECTORS

Input AC Power Connector

Each Sparc-le 20 unit is supplied with its own ac line cord. Depending upon the model ordered, there is either a line cord with a U.S. 115 V ac three-prong plug or a line cord with a German two-prong plug for 220 V ac operation. Each unit is wired to accept the line voltages associated with the line cord provided.

See “Connecting AC Input Power” on page 5-4 for installation information.

Input DC Power Connector

The output of the MDX magnetron power supply becomes the input dc to the Sparc-le 20 unit. The standard input dc connector to the Sparc-le 20 unit is a UHF male connector (Amphenol 83-822). A 2-position terminal block or MS-3470 connector is optional on the Sparc-le 20 unit (see "Military Style Connectors (Optional)" on page 4-3).

With units featuring the standard UHF dc input connector, an assembled 6-foot cable, connectors, and insulating sleeves are provided at the time of purchase. The cable end that has the long insulating sleeve over the UHF connector is intended to be connected to the MDX output.

See "Connecting the DC Input and Output" on page 5-4 for more information.

> ⚠ **WARNING:**
> Ensure that the input dc power connector is connected to the Sparc-le 20 input connector labeled "MDX" and that the output dc power connector is connected to the Sparc-le 20 output connector labeled "CHAMBER". Also ensure that you maintain proper *polarity* when making these connections. Failure to correctly connect input and output power could result in damage to the unit.

Output DC Power Connector

The standard output dc power connector is the same type of male UHF connector with insulating sleeve as is used for the input. This connector and sleeve are provided with the unit at the time of purchase; the cable is not provided. A 2-position terminal block or MS-3470 connector is optional on the Sparc-le 20 unit (see "Military Style Connectors (Optional)" on page 4-3).

See "Connecting the DC Input and Output" on page 5-4 for installation information.

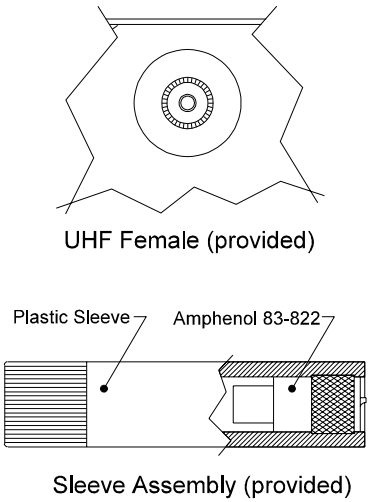

Figure 4-1. Standard UHF-type dc input and output connector

Terminal Block Connectors (Optional)

A 2-position terminal block connector is optional on the Sparc-le 20 (Figure 4-2). See “Connecting the DC Input and Output” on page 5-4 for installation information.

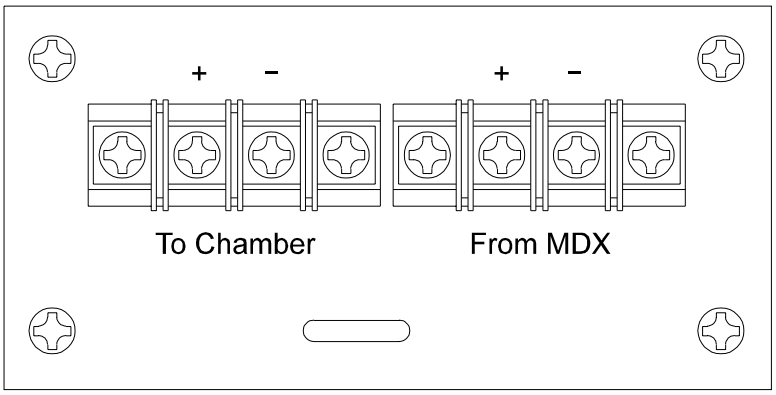

Figure 4-2. Optional terminal block connector for dc input and output

Military Style Connectors (Optional)

Military style connectors are optional on the Sparc-le 20. The MS-3470 dc input connector is a male MS3470 connector; the MS-3470 dc output connector is a female MS-3470 connector (See Figure 4-3). The pin descriptions, described in Table 4-1 and Table 4-2, are the same for both the input and output.

The full military specification numbers for these connectors are MS3470-L18-8P and MS3470-L18-8S, respectively. Recall that cabling and other attached components (a mating connector, for example) for these connectors also have military specification numbers. To configure and/or assemble connecting components, refer to the appropriate military specifications. AE does not supply mating connectors.

See “Connecting the DC Input and Output” on page 5-4 for installation information.

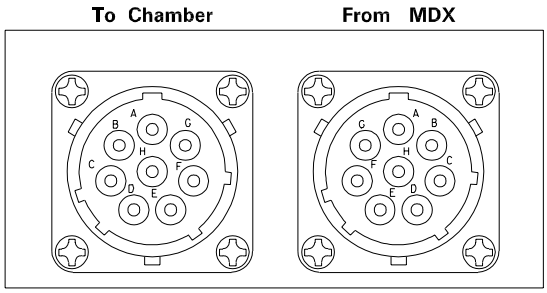

Figure 4-3. Optional MS-3470 connector

Pin Descriptions for Male Connector

The following table lists the pin descriptions for the male connector:

Table 4-1. Pin Descriptions for Male Connector

Pin Letter	Description
A	Unused; do not connect
B	Positive return (to dc supply)
C	Ground
D	Interlock
E	Interlock
F	Ground
G	Unused; do not connect
H	Negative supply (from dc supply)

Pin Descriptions for Female Connector

The following table lists the pin descriptions for the female connector:

Table 4-2. Pin Descriptions for Female Connector

Pin Letter	Description
A	Unused; do not connect
B	Positive return (from chamber)
C	Ground
D	Interlock
E	Interlock
F	Ground
G	Unused; do not connect
H	Negative supply (to chamber)

Remote Control Panel Connector

Connections for remote control of the Sparc-le 20 unit can be made through a 9-pin, female, D subminiature connector. This female connector and housing are provided with the unit at the time of purchase.

BNC, Activation-counting Port

A BNC connector, referenced to chassis ground, is provided and available to be connected to an external counter. A 5-V, 5-µs pulse is generated each time the Sparc-le 20 unit is activated to repress an arc. This pulse width is less when the unit is experiencing an over-current condition. The self-run frequency is not present at this output.

User Analog/Digital I/O Port

The table below provides information about each pin on the User port connector. See “Connecting AC Input Power” on page 5-4 for details on making this connection.

The User connector is primarily an “analog” interface that allows the use of a remote controller.

User Port Pin Descriptions

The following table provides information about each pin in the User port connector.

Table 4-3. User Port Pin Descriptions

Pin	Name	Description
pin 1	OUTCOM.D	This is a dedicated return line to the MDX. It is connected to chassis ground and then to protective earth-ground at the MDX.
pin 2	+15 VDC	This is a voltage which must be applied to Sparc-le 20's interface circuits. A capability of 50 mA is required.
pin 3	$\overline{ENABLE.D}$	This 15 Vdc signal must be pulled low to activate Sparc-le 20's active arc-handling mode. The user must be able to sink 20mA from this pin
pin 4	$\overline{SELFRUN.D}$	This 15 Vdc signal must be pulled low to activate Sparc-le 20's self-run mode. The user must be able to sink 20 mA from this pin
pin 5	INTCOM.A	This signal connects to the internal Sparc-le 20 ground. It is active on pin 5 only when **S1** on the Sparc-le 20's logic board has been activated.
pin 6	SUPERVC.D	This collector is normally connected to +15 VDC (pin2) through switch **S2-1** being closed on Sparc-le 20 logic board. (For more information about logic board switches, see page 3-5.)
pin 7	SUPERVE.D	This signal is low or open during a fault of Sparc-le 20's active arc-handling mode. This also shows a fault when the input dc voltage to Sparc-le 20 is too low or too high to operate while in the active arc-handling mode. This pin will sink up to 2 mA.
pin 8	+15VDCINT	This signal connects to the internal 15 V dc used to power Sparc-le 20's logic circuits. It is active only when **S1** on the Sparc-le20 logic board has been activated. It can only source 50 mA.
pin 9	OVERTEMP/AC PWR/ INTERLOCK.D	This 0-15 V dc signal opens whenever an overtemperature trip has occurred in the Sparc-le 20 unit, whenever the ac line cord has been disconnected, or whenever an interlock switch is open. This pin will sink up to 2 mA maximum.

Note: A ".A" appended to a pin name indicates an analog signal; a ".D" appended to the pin name indicates a digital signal. An overline on the signal name indicates that the signal is true when low.

INDICATORS

Status Signals

Status signals can be externally monitored by means of an output line on the User port. Digital signals are 0 to 15 V.

Table 4-4. Status Signals

Pin	Name	Function
9	*OVERTEMP/AC PWR/INTERLOCK.D*	Opens when overtemperature condition or loss of ac power occurs
7	*SUPERVE.D*	Opens when the active arc-handling function is not operating properly

Front Panel Indicators

There are seven LED indicators on the Sparc-le 20 front panel. See the panel drawings at the end of this chapter for LED locations. The table below provides details.

Table 4-5. Front Panel Indicators

LED Name	Function
Power On/ready	Green LED; lights to indicate that power is on
Mode Override (Overvoltage/overtemp)	Yellow LED; lights to indicate an internal overtemperature or over-voltage condition. The operating mode is automatically switched to ARC-OUT enhancement mode. When the fault condition clears, Sparc-le20 automatically switches back to the prior operating mode, and this LED goes out.
Active Arc	Green LED; lights to indicate that active arc-handling mode has been selected with the **OPERATING MODE** switch
Self Run	Green LED; lights to indicate that self-run mode has been selected with the **OPERATING MODE** switch
Local	Green LED; lights to indicate local control-from the Sparc-le20 unit's front panel
Remote	Green LED; lights to indicate remote control-from the Sparc-le20 unit's User port

UNIT ILLUSTRATIONS

Front View of the Sparc-le 20

Figure 4-4. Front View of the Sparc-le 20

Rear View of Sparc-le 20

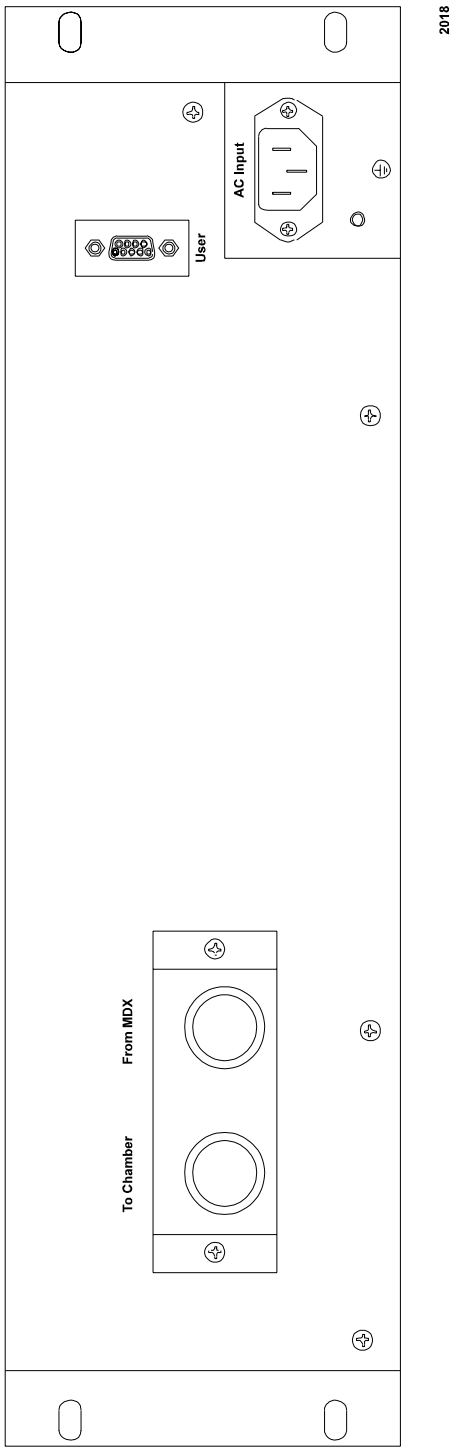

Figure 4-5. Rear View of the Sparc-le 20

Rear View of Sparc-le 20 (MS-3470 Connectors)

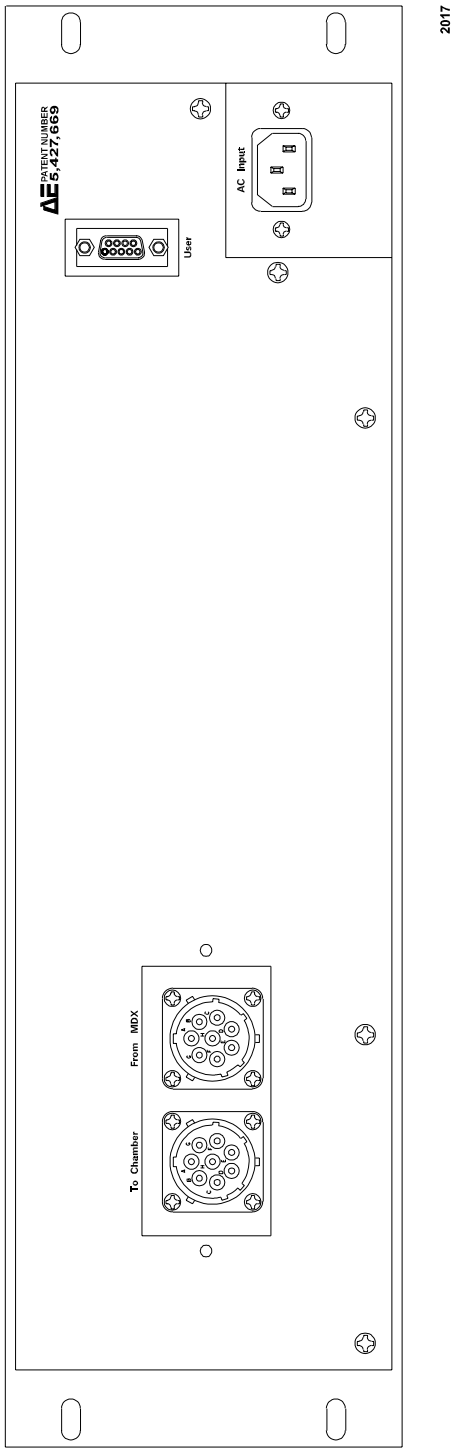

Figure 4-6. Rear View of the Sparc-le 20 with military style connectors

Rear View of Sparc-le 20 (Terminal Block)

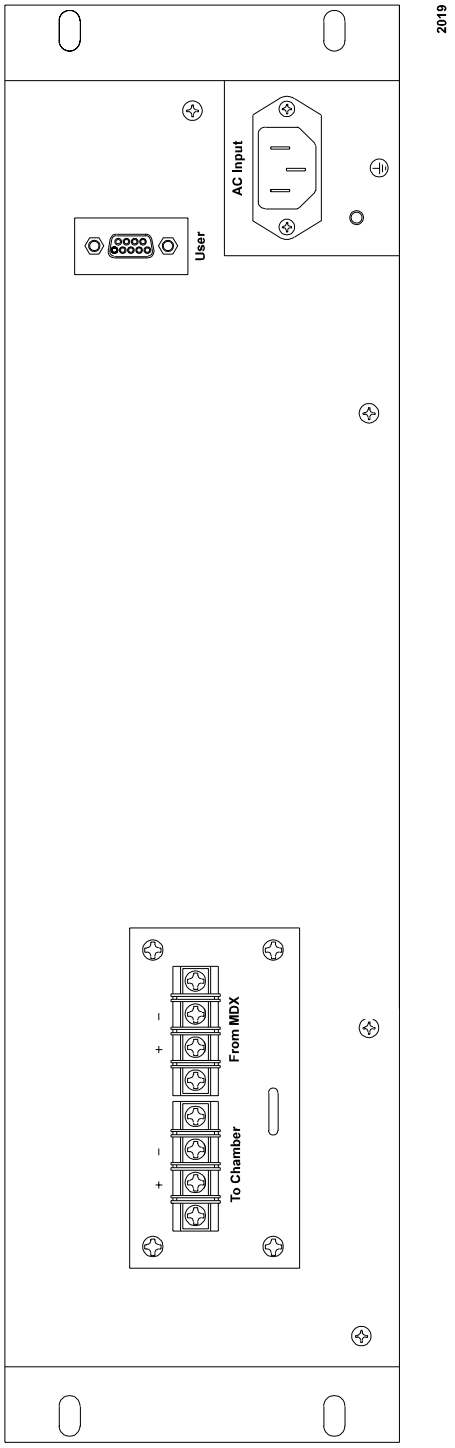

Figure 4-7. Rear view of Sparc-le 20 with terminal block

Dimensions

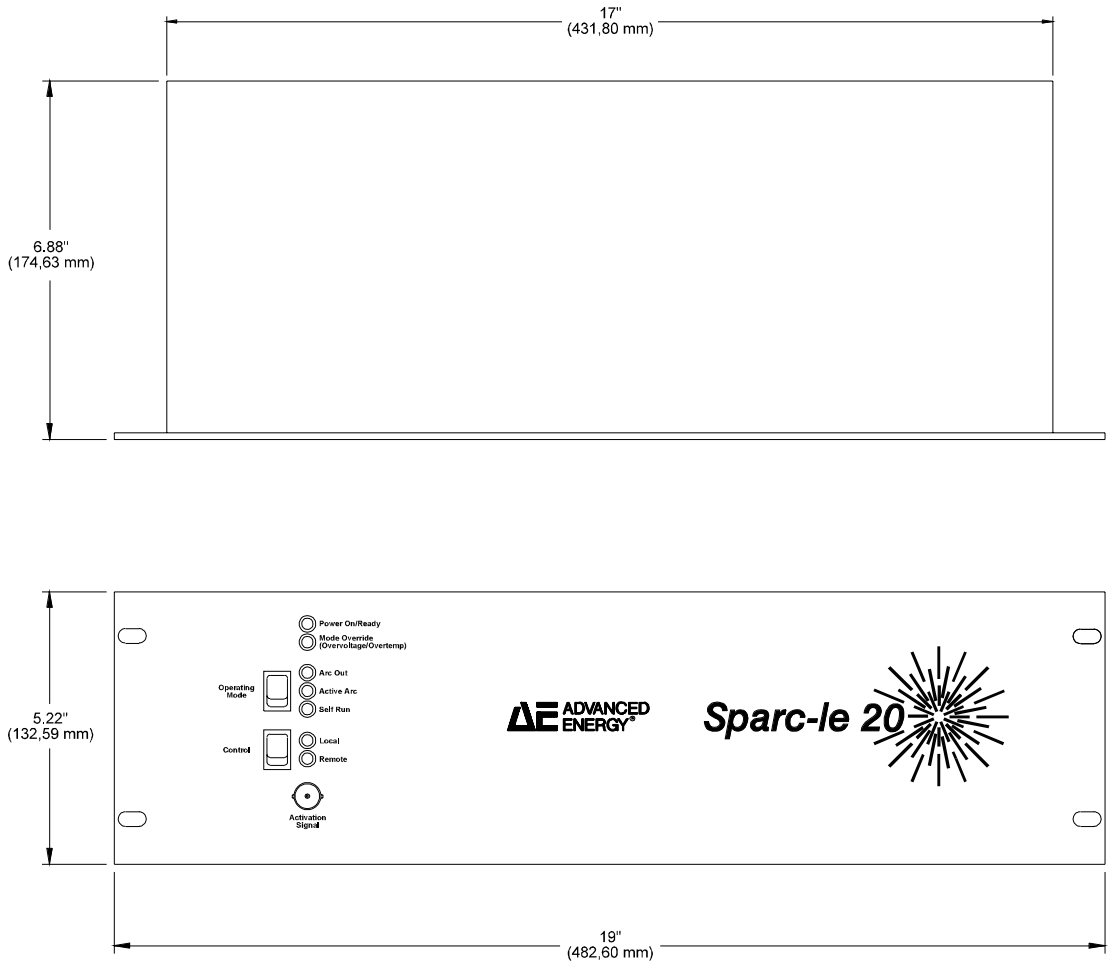

Figure 4-8. Dimensions

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SETTING UP

Unpacking

Unpack and inspect your MDX Sparc-le 20 accessory carefully. Check for obvious physical damage. If no damage is apparent, proceed to make the connections. If you do see signs of shipping damage, contact Advanced Energy Industries, Inc., and the carrier immediately. Save the shipping container for submitting necessary claims to the carrier.

Design Considerations

The Sparc-le 20 technology performs best when it is physically located within 6 m (20 ft) of cable distance from the chamber cathode. The Sparc-le 20 unit is made to bolt into either the front or rear of a rack. Cooling of the Sparc-le 20 unit is provided by an internal fan. Take precautions when mounting the unit to prevent its air flow from being restricted.

Cooling Requirements

The Sparc-le 20 unit contains its own internal fan for cooling. When you install a Sparc-le 20 unit on your system, ensure that it is in a location where its maximum ambient temperature is not exceeded (see “Environmental Specifications” on page 3-3) and where its air vent inlets and outlets are not obstructed.

Logic Board Switches

> ⚠ **DANGER:**
> Before removing the Sparc-le 20 unit cover, take proper precautions against ESD (electro-static discharge). Potential damage to the unit could occur.

Note: Before removing the Sparc-le 20 unit cover, take proper precautions against ESD (Electro-static discharge). Potential damage to the unit could occur.

To set the switches discussed in the following sections, you must access the logic board by removing the unit cover. Before removing the unit cover, remove ac and dc input power from the Sparc-le 20 unit, take proper precautions against ESD (electro-static discharge), and take care to remove all unit cover screws. If you are uncertain about this procedure, please contact the nearest AE Customer Service office.

Changing Self-run Frequency

A switch on the logic board has been provided so that you can change the self-run frequency from 20 kHz to 2 kHz. Units shipped from the factory always have this switch set in the 20 kHz position. The self-run frequency can be changed via an access port located at the rear of the unit.

> ⚠ **CAUTION:**
> Do not change the frequency setting while the unit is operating. Turn off the DC supply and unplug the SPARC-LE 20 line cord before changing the frequency setting.

Change the frequency by using a small screwdriver to rotate the frequency control switch located at the rear of the unit. The slot in the rotary switch is vertical for 20 kHz operation or horizontal for to 2 kHz operation. Do not rotate the switch past the 20 kHz or 2 Khz position as shown in Figure 5-1. Only the self-run frequency is affected; the rate at which arcs are handled remains the same.

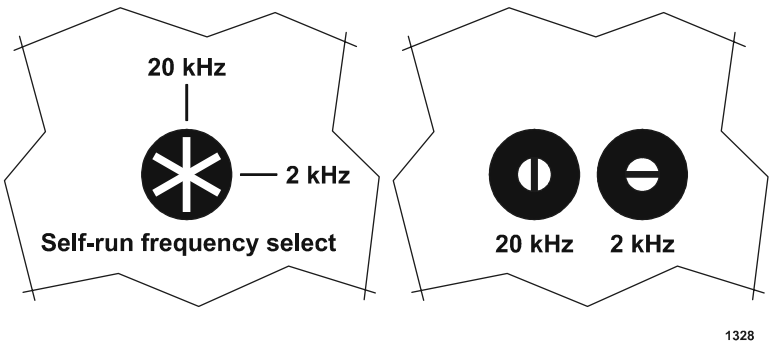

Figure 5-1. Frequency change switch

Using the Interlock Switch Option

The cover over the input and output connectors engages an interlock switch. This switch is bypassed on units shipped from the factory by switch **S2-2** on the logic board. This allows the Sparc-le 20 unit to be evaluated without the User port functions. When you are ready to take advantage of the User port functions and the interlock switch, open switch **S2-2**. (The interlock switch is not applicable with the MS-3470 units.)

MAKING REAR PANEL CONNECTIONS

Grounding

A protective earth terminal stud is located next to the input ac line cord connector. This terminal is connected internally to the input line cord ground wire at the ac line cord connector.

> ⚠ **DANGER:**
> Connect the protective earth terminal on the MDX rear panel to protective earth-ground before making any other connection.

Note: For optimum performance, ground the chassis stud to the chamber ground.

Connecting AC Input Power

The ac input line connection is made through a line cord possessing either a standard US three-prong 115 V ac type or a two-prong German 220 V ac type plug. When a unit is purchased, it is internally connected for the correct line voltage at the factory and then supplied with the appropriate line cord. A sticker located next to the line cord connector indicates the voltage for which the unit has been wired. The range of input line voltages for each case and the associated line cord plug are listed below.

- U.S. 115 V ac plug: 90-126.5 V ac rms, 50/60 Hz, single phase, 30VA
- German plug: 180-253 V ac rms 50/60 Hz, single phase, 30 VA

It is important to note that for the Sparc-le 20 unit to operate in its active arc-handling mode, ac input power must be present. Operation of the system with the Sparc-le 20 line cord unplugged restricts it to Arc Out enhancement mode operation only.

Connecting the DC Input and Output

A female UHF-type connector is standard for both the dc input and output on the MDX Sparc-le 20 unit (see Figure 4-1 on page 4-2). As a result, both the input and output connections are made by means of a male UHF-type connector (Amphenol 83-822), which AE provides. The RG-8U cables for both input and output are not included with the Sparc-le 20 unit, but can be purchased from AE separately.

An optional terminal block connector (see Figure 4-2 on page 4-3) or MS-3470 connector (see Figure 4-3 on page 4-3) are available for dc input and output. See the following section for instructions on connecting to these types of connector

CONNECTING TO THE TERMINAL BLOCK

The optional terminal block connector features two positions each for dc input and dc output. To connect to the terminal block, follow these steps.

1. Ensure that ac input power has been removed from the Sparc-le 20 unit.
2. Power off the MDX power supply.
3. Remove the connector cover from the rear of the Sparc-le 20 unit.
4. Slide the appropriate cables up through the two holes in the bottom of the connector cover and out the back of the cover (see Figure 5-2 on page 5-5).
5. Attach the cables to the appropriate positions on the connector, taking care to maintain proper polarity.
6. Re-attach the connector cover (see Figure 5-2 on page 5-5).

Note: The connector cover features a metal tongue that slides into a slot on the connector plate. Inserting this tongue into the slot provides interlock when switch **S2-2** is open. (For more information about the interlock switch, see “Using the Interlock Switch Option” on page 5-3.)

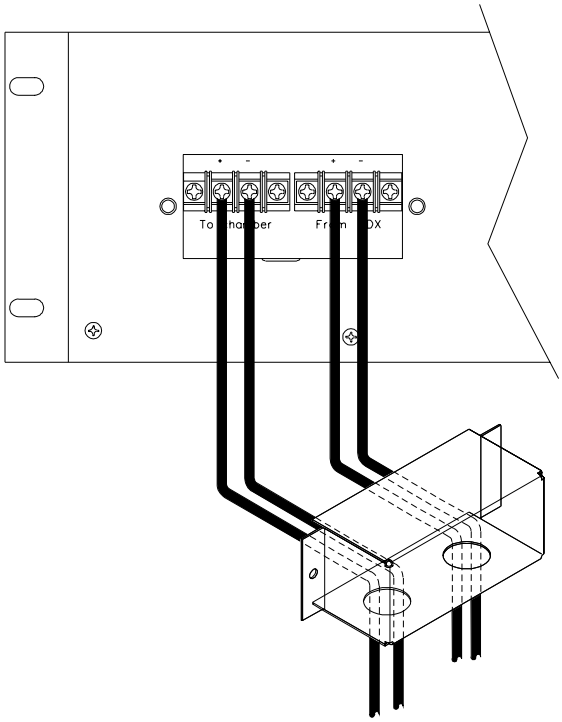

Figure 5-2. Connecting dc input and output to the terminal block

CONNECTING TO THE MS-3470 CONNECTORS

To connect the optional military style connector to the terminal block, follow these steps.

1. Ensure that ac input power has been removed from the Sparc-le 20 unit.
2. Power off the MDX power supply.
3. Attach the cables to the appropriate connectors.

Operation

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Front Panel (Manual) Control 6-1
User Port Control 6-1
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METHODS OF CONTROL

You can control the Sparc-le 20 unit from the front panel switches or from the User port through optically coupled signals. The interfacing functions available on the Sparc-le 20 unit are represented by the abbreviated schematic (Figure 6-3 on page 6-4). Units are shipped from the factory configured for User port control.

Front Panel (Manual) Control

A Sparc-le 20 unit can be controlled manually from the front panel. Select **LOCAL** with the two-position **CONTROL** switch. Then use the three-position **OPERATING MODE** switch to select an operating mode. Although the manual method of operation limits the available options, it does allow the unit to be quickly evaluated on a system without adding additional control cables.

User Port Control

The Sparc-le 20 unit can be operated through the User port on the rear panel. For User port operation, connect the jumpers on the female cheater plug (on the logic board) as shown in Figure 6-1. See “Logic Board Switches” on page 5-2 for more information.

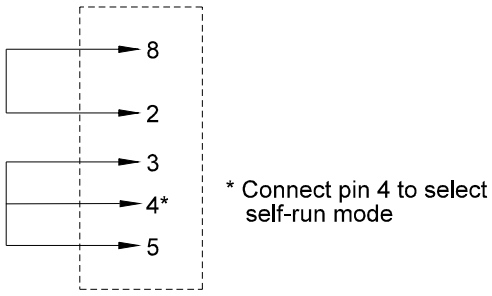

Figure 6-1. Connector jumpers for User port operation of Sparc-le 20

The User interface connector is a 9-pin, male, subminiature-D connector located on the rear panel. Details of each of these signals and their function are described in “User Port Pin Descriptions” on page 4-6.

The Sparc-le 20 unit can also be operated through the MDX User port. Both switches on the **S1** switch assembly must be open and no jumpers should be installed in the female cheater plug for MDX control. (For more information about setting the switches on the logic board, “Logic Board Switches” on page 5-2.) The control lines used on the MDX to control Sparc-le 20 unit are illustrated in Figure 6-2. As can be seen from Figure 6-2, when CS2.D is selected at the MDX, then Sparc-le 20 unit is activated. The Sparc-le 20 self-run mode is selected in a similar manner using the MDX unit's CS1.D line. When using the MDX to control a cathode switch box, another means is required to control Sparc-le 20.

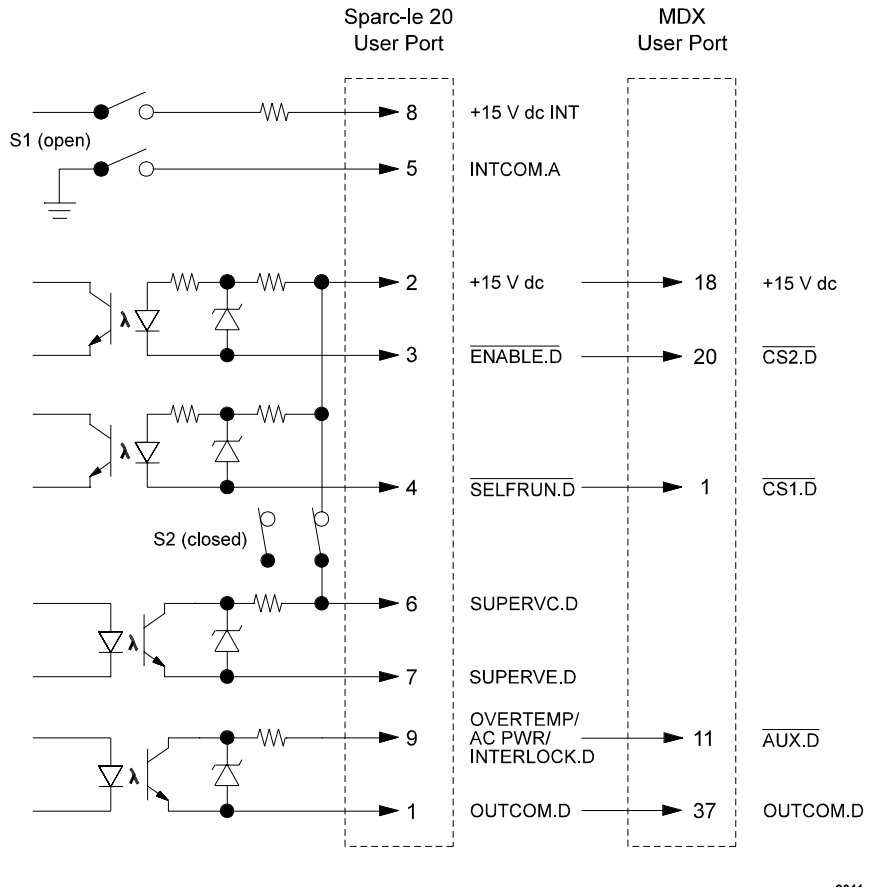

Figure 6-2. MDX User port control of Sparc-le 20

The following chart illustrates how the three operating modes of the Sparc-le 20 unit can be selected using the MDX User port functions and the Sparc-le 20 User port.

Table 6-1. Operating Modes

Target	CS1.D	CS2.D	Sparc-le 20 operating mode
1	Low	High	arc-out enhancement
2	High	Low	active arc handling
3	Low	Low	self run

SUPERVISORY CIRCUIT

An internal supervisory circuit within the Sparc-le 20 unit monitors its function in the active arc-handling and self-run modes. The purpose of this error signal (*User pin 7, SUPERVE.D*) is to notify the operator that Sparc-le 20 is not functioning properly. This signal is intended to be handled independently of the MDX User port, preferably by the system controller. This is because the decision as to whether or not to shut off the MDX should be made at the system level. Switch assembly **S2-1**, located on Sparc-le 20's logic board, must be in its closed position to make the fault signal low on Sparc-le 20's *User pin 7* (Figure 6-3 on page 6-4). "Logic Board Switches" on page 5-2 for more information about setting the switches on the logic board.

Note: You need to supply a 5 kW pull-down resistor for *User pin 7*.

Load current must exceed 1.5 A before the supervisory circuit becomes functional.

FACTORY CONFIGURATION

When Sparc-le 20 is shipped, positions **1** and **2** on switch **S1** are set **OPEN**, and positions **1** and **2** on switch **S2** are set **CLOSED**. The self-run frequency is set to 20 kHz.

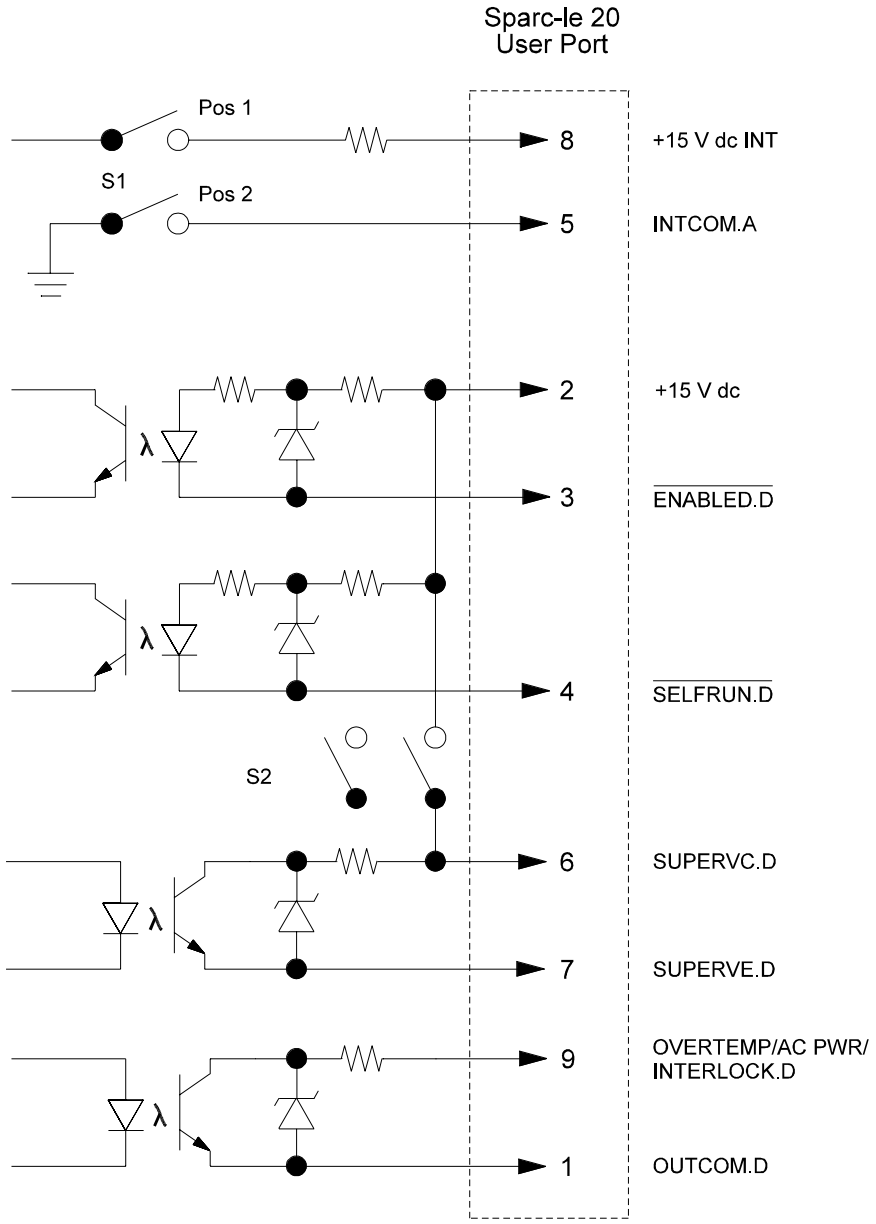

Figure 6-3. Sparc-le 20 User port signal lines

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BEFORE CALLING AE CUSTOMER SUPPORT

> ⚠ **WARNING:**
> RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.

Checks with the Power Off

1. Make sure the power switch is off.
2. Check for visible damage to the unit, cables, and connectors.
3. Make sure all unit connectors are installed correctly and are fastened tightly.
4. Check to determine whether any system-related circuit breakers have been tripped.
5. Make sure there is input power to the unit and make sure it meets specifications.
6. Make sure ground connections are adequate and secure.

Checks with the Power On

1. Check the unit's input power connections to ensure the proper power is being supplied to the unit.
2. Check unit's LEDs to determine that the proper ones are lit.

AE CUSTOMER SUPPORT

Please contact one of the following offices if you have questions:

Table 7-1. Customer Support Locations

Office	Telephone
AE, World Headquarters 1625 Sharp Point Drive Fort Collins, CO 80525 USA	Phone: 970.221.0108 or 970.221.0156 Fax: 970.221.5583 Email: technical.support@aei.com
AE, Voorhees, NJ 1007 Laurel Oak Road Voorhees, NJ 08043 USA	Phone: 609.627.6100 Fax: 609.627.6159 Email: pete.potter@aei.com
AE, California 491 Montague Expressway Milpitas, CA 95035 USA	Phone: 408.263.8784 Fax: 408.263.8992 Email: allen.vallei@aei.com
AE, Austin 8900 Cameron Road Suite 100 Austin, TX 78754	Phone: 512.231.4200 Fax: 512.719-9042
AE, GmbH Raiffeisenstrasse 32 70794 Filderstadt (Bonlanden) Germany	Phone: 49.711.77927.0 Fax: 49.711.7778700 Email: kamel.ferdi@aei.com
AE, Japan KK TOWA Edogawabashi Bldg. 347 Yamabuki-cho Shinjuku-ku, Tokyo Japan	Phone: 81.3.32351511 Fax: 81.3.32353580 Email: okamoto.tetsu@aei.com
AE, Korea Ltd. Gongduk Building, 4th floor 272-6 Seohyun-Dong, Bundang-Gu, Sungam Si Kyunggi, 463-050 Korea	Phone: 82.342.705.1200 Fax: 82.342.705.276 Email: sung.lee@aei.com
AE, United Kingdom Unit 5, Minton Place, Market Court, Victoria Road Bichester, Oxon OX6 7QB UK	Phone: 44.1869.320022 Fax: 44.1869.325004 Email: catherine.kendall@aei.com

RETURNING UNITS FOR REPAIR

Before returning any product for repair and/or adjustment, ***first follow all troubleshooting procedures***. If, after following these procedures, you still have a problem or if the procedure instructs you to, call AE Customer Support and discuss the problem with a representative. Be prepared to give the serial number of the unit and the reason for the proposed return. This consultation call allows Customer Support to determine whether the problem can be corrected in the field or if the unit needs to be returned. Such technical consultation is always available at no charge.

If you return a unit without first getting authorization from Customer Support and that unit is found to be functional, you will be charged a re-test and calibration fee plus shipping charges.

To ensure years of dependable service, Advanced Energy® products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide. All parts and labor carry our standard one-year warranty.

WARRANTY

Advanced Energy® products are warranted to be free from failures due to defects in material and workmanship for 12 months after they are shipped from the factory (please see warranty statement below, for details).

In order to claim shipping or handling damage, you must inspect the delivered goods and report such damage to AE within 30 days of your receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

- Be made within the applicable warranty period
- Include the product serial number and a full description of the circumstances giving rise to the claim
- Have been assigned a return authorization number (see below) by AE Customer Support

All warranty work will be performed at an authorized AE service center (see list of contacts at the beginning of this chapter). You are responsible for obtaining authorization (see details below) to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized AE service center. AE will return the repaired unit (freight prepaid) to you by second-day air shipment (or ground carrier for local returns); repair parts and labor will be provided free of charge. Whoever ships the unit (either you or AE) is responsible for properly packaging and adequately insuring the unit.

Authorized Returns

Before returning any product for repair and/or adjustment, call AE Customer Support and discuss the problem with them. Be prepared to give them the serial number of the unit and the reason for the proposed return. This consultation call will allow Customer Support to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

Units that are returned without authorization from AE Customer Support and that are found to be functional will not be covered under the warranty (see warranty statement, below). That is, you will have to pay a retest and calibration fee, and all shipping charges.

Upgrading Units

AE's products are continually changing as ways to improve them are discovered. AE is happy to upgrade older units so that they reflect recent improvements. The fee for upgrading a unit will be a percentage of the current list price, based on the age of the unit. Such an upgraded unit will carry a 6-month warranty (which will be added to any time remaining on the original warranty). Contact Customer Support for specifics on getting an older unit upgraded to the current revision level.

Warranty Statement

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed AE specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is 12 months after the date the goods are shipped from AE. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final.

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